The severity of pediatric pain in relationship to school-related functioning and teacher support: An epidemiological study among school-aged children and adolescents

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ABSTRACT

The current cross-sectional study examined child and adolescent pain severity in relation to various domains of school functioning and, in line with self-determination theory, the potentially protective role of perceived teacher support of child/adolescent autonomy and competence. Data from a large representative sample of Flemish school children and adolescents (N = 10650; 50.8% boys; Age Range 10-21 years; M_{age}=14.33) was collected as part of the WHO collaborative Health Behaviour in School-Aged Children (HBSC) survey. Child/adolescent pain severity was graded based upon a pediatric pain classification system adapted from that of Von Korff et al. The current study thus provided insight regarding the prevalence of pain among Flemish children/adolescents and, extending the limitations of existing literature, examined the specific role of pain severity across various domains of school functioning. Findings indicated that a sizeable proportion of children reported moderate to severe pain problems (i.e., about 14 % of children and adolescents were classified in the highest pain Grades: i.e., Grade III or IV). Further, higher pain grades were associated with poorer outcomes across all indices of school functioning (i.e., school absenteeism, school-related pressure and satisfaction and bullying experiences), with the exception of academic performance. However, the association between pain grade and school absenteeism was less pronounced when children perceived their teachers to be highly supportive of competence and autonomy. Further, teacher support of competence appeared to buffer against the harmful effects of severe pain upon instances of bullying experiences at school. Future research directions and implications for school-based interventions are discussed.

1. INTRODUCTION (word limit: 500/ word count: 500)

Pain is a common experience in children and adolescents [31,43] that may inhibit or compromise participation in activities typical for their developmental level [16,18,39]. Among activities in which children and adolescents typically engage, school-related activities are centrally important and thus likely to be affected by pain. Indeed, research among pediatric chronic pain samples and preliminary findings among community samples has shown that pain is associated with higher school absenteeism [20,24,27,28,32]. To date, only a handful of studies have extended investigation of school impairment beyond school absence, and a similarly small number look specifically at the role of pain severity. These studies show associations between pain and difficulty coping with school demands [25], decline in academic performance [4,38] and increased peer victimization [22,25,29]. As hampered school functioning may pervasively impact child/adolescent development [13,15], understanding factors buffering the harmful effects of pain upon school functioning is critically important. Yet, pediatric pain literature addressing protective factors within the school setting is surprisingly scarce [3,36].

Teaching styles may exert a strong protective influence on school outcomes [11,25,34,55]. Research drawing on Self Determination Theory (SDT) applied to educational settings suggests that teachers' support of child/adolescent *autonomy* (enhancing children's self-initiation/regulation of personal behaviour) and *competence* (enhancing children's sense of competence as learners, including setting optimal challenges and performance feedback) may be particularly relevant in this regard [12,40,46]. In line with this, both teacher support dimensions (i.e., of autonomy and competence) have been found to be associated with improved school functioning reflected by lower school drop-out [56], higher school satisfaction/motivation [40] and grades [2,58]. Furthermore, preliminary research has shown that teachers' competence and autonomy support decreased the negative impact of stress upon

school-related functioning [44]. Given earlier findings indicating child/adolescent pain is associated with lower perceived competence [6,65] and autonomous behaviour [16,42] this may be particularly important in the context of pediatric pain, and hence, it is plausible that teacher support of child/adolescent competence and autonomy may also act as a resilience resource, protecting the child against harmful effects of severe pain upon school-related functioning.

The current study was undertaken as part of the World Health Organization's survey "Health Behaviour in School-Aged Children" (HBSC) [9,10,48] and aimed to examine the relationships between pain, teacher support, and school outcomes in a large representative sample of Flemish-speaking school-aged children and adolescents. Child/adolescent pain severity was graded based upon a classification system adapted from Von Korff et al. [27,63,64]. Accordingly, the current study also aimed to provide insight into the prevalence of pain among (Flemish) children/adolescents while taking into account its severity and, as such, addresses a major limitation of previous epidemiological studies that reported on prevalence of pain without analyzing its severity or impact [24,43,61 but see 27]. We hypothesized that 1) higher pain severity is associated with worse school functioning and that 2) higher levels of teacher competence and autonomy support buffer against the harmful effects of severe pain upon school functioning. By assessing school functioning outcomes beyond school absenteeism (i.e., school-related pressure and satisfaction, academic performance and bullying experiences), we sought to extend the current scope of our understanding of the effects of pain on school experience.

2. METHODS

2.1 Participants

The data for the present study were obtained from the 2009-2010 survey of Flemish Health Behaviour among School-aged Children (HBSC). This is a four-yearly cross-national and cross-sectional research study conducted in collaboration with the WHO Regional Office for Europe [10,48]. The HBSC study aims to gain insight into young people's health and well-being, health behaviour and their social context. The HBSC study aims at drawing nationally representative samples and uses cluster sampling (school or classes) as sampling method with samples being stratified to ensure representation by age, sex and school type. For the 2009-2010 survey, the Flemish speaking region of Belgium included, besides the core HBSC questions related to pain, additional items assessing pain and pain-related characteristics in their survey (see measures section). The survey was conducted from March 2009 to May 2009. More details on study procedure can be found in the standardized international research protocol which was followed to ensure consistency in data collection and processing procedures [48] (see: http://www.hbsc.org/publications/international/). The survey is approved by the Ethics committee of the University Hospital of Ghent, project 2009/662.

One hundred forty primary Flemish schools in grades 5 and grades 6 and 270 secondary Flemish schools in grades 7 through 12 were invited to participate. Fifty six primary schools (40%) and 66 secondary schools (24%) agreed to participate. Questionnaires were administered in school classrooms by the teachers. The time frame for filling out the questionnaires was one school hour. Secondary schools were provided with the opportunity to have students fill out the questionnaires online. Only 5.7% of the participating secondary schools choose this online format. Of the 11726 children and adolescents approached, 291 (2.5%) children/adolescents did not participate because of school absence due to illness when questionnaires were administered, 177 (1.5%) did not participate because parents refused child participation and 143 (1.2%) did not participate for another reason (e.g., doing an

internship, being suspended). Further, 295 (2.5%) of the questionnaires returned empty owing to lack of time to fill out the questionnaires during school hours and 170 (1.4%) were considered invalid (i.e., due to missing basic socio-demographic information, inconsistent responding, or leaving the majority of the items blank), resulting in a final sample of 10650 children and adolescents. The sample consisted of an equal distribution of boys (50.8%) and girls (49.2%). Mean age was 14.33 years (*SD*=2.44). Approximately 15% of the children and adolescents were recruited from the fifth grade, 11% from the sixth grade, 15% from the seventh grade, 13% from the eighth grade, 12% from the ninth grade, 13% from the tenth grade, 13% from the eleventh grade and 9% from the twelfth grade. The majority of the children and adolescents (66%) grew up in a classic family. About half of the children and adolescents (51%) reported medium family affluence, 21% reported low and 27% reported high family affluence.

2.2 Measures

2.2.1 Sociodemographic measures

Information about age, sex, school grade, family situation and socioeconomic status was collected at the time of questionnaire administration. Family situation was coded as 'classic family unit'; 'one-parent family'; 'parent and stepparent' or 'other'. Family affluence was used as an indicator for individual socioeconomic status [8,9]. The family affluence scale (FAS) is a composite indicator of self-reported socioeconomic status comprising four items that address family assets or conditions that indicate wealth; 'Does your family own a car, van or truck? (0= no; 1 = yes one; 2 = two or more); Do you have your own bedroom for yourself? (0 = no; 1 = yes); During the past 12 months, how many times did you travel away on holiday with your family? (0 = not at all; 1 = once; 2 = twice, 3 = more than twice); How many computers does your family own? (0 = none; 1 = one; 2 = two, 3 = more than two).

Responses are summed on a 1 to 10 scale with higher scores indicating greater affluence. The score (0-9) was divided into tertiles (low, medium, high FAS-score).

2.2.2 Pain Characteristics

Several measures were used to assess pain-related characteristics including pain intensity, frequency, health care utilization because of pain, pain location and most troublesome pain. Most of these measures were –among the Flemish speaking region of Belgium- added to the mandatory 2009/2010 HBSC survey which only included assessment of the frequency of headache, stomach-ache and backache during the past 6 months.

2.2.2.1 Pain intensity

Children's and adolescents' experienced pain intensity was assessed by means of 3 items. Child and adolescent participants rated their current pain intensity, their worst and average pain intensity during the past 6 months on a 0-10 numerical rating scale (NRS) with the end points 'no pain' and a 'lot of pain'. Mean pain intensity was calculated as the mean of current pain intensity, and worst and average pain intensity during the past 6 months

2.2.2.2 General pain frequency

Children and adolescents were also requested to indicate the number of days they had experienced pain during the past 6 months.

2.2.2.3 Health care utilization

Health care utilization because of a pain problem was assessed by asking children to indicate the number of times they had consulted their general practitioner or specialist in the past 6 months because of their pain.

2.2.2.4 Specific pain location, frequency and most troublesome pain

Specific pain location(s) and its frequency were assessed by means of 9 items referring to different pain locations (i.e., headache, stomach ache, back pain, neck pain, ear pain, sore throat, chest pain, musculoskeletal pain (referred to as pain in the arms or hand, legs or feet)

and other pain); for each pain location, children were required to indicate the frequency of pain in the last six months on a five point scale; (1) about every day, (2) more than once a week, (3) about every week, (4) about every month or (5) rarely or never. As stomach ache in girls may be dependent upon whether they have begun to menstruate (have periods), girls were also requested to indicate (yes/no) whether they have begun to menstruate. Additionally, children were also requested to report on their most troublesome pain location. Specifically, children had to indicate which pain complaint (i.e., headache, stomach ache, back pain, neck pain, ear pain, sore throat, chest pain and musculoskeletal pain or other) had troubled them the most in the past 6 months.

2.2.3 Pain severity – Calculation of Pain Grades

The severity of a child's pain problem was graded based upon the Graded Chronic Pain Scale [GCPS; 63]. The original GCPS consists of 7 items and classifies participants into one of five categories according to characteristic pain intensity and disability indexed by disability days and pain interference. For the application in the current study, 5 of the 7 original items were used. Specifically, and similar to the original GCPS, the current study included characteristic or *mean pain intensity* calculated as the mean of current pain intensity, and worst and average pain intensity during the past 6 months (see also 2.2.2.1). Pain intensity was categorized into low (<5) versus high (≥5) pain according to the original GCPS. The number of *disability days* was indexed by one item assessing the number of days in the last 6 months the child/adolescent had been kept from doing his/her usual activities. Number of disability days (0-180) were classified in disability points according to Von Korff et al. [63]; i.e., 0-6 days: 0 points, 7-14 days: 1 point; 15-30 days: 2 points and > 31 days: 3 points. The GCPS slightly differed from the original GCPS in that *pain interference* was assessed by means of 1 instead of 3 items. Specifically, in the original GCPS pain interference in the past 6 months is assessed by means of three items indexing interference with daily/usual activities,

recreational/social and family activities and work (including housework). Since the majority of children/adolescents are not employed and since the remainder two items substantially overlap, only the item assessing interference with daily/usual activities was used; i.e., children/adolescents were requested to rate the degree to which pain interfered with their daily/usual activities in the past 6 months using an 0-10 NRS with the endpoints ranging from 'no interference' to 'unable to carry on any activities'. Degree of interference was classified into disability points according to the original procedure; i.e., <3 interference score: 0 points: ≥3 and <5 interference score: 1 points; ≥5 and <7 interference score: 2 points and ≥7 interference score: 3 points. Based on characteristic pain intensity and total disability points, pain severity was classified in 5 grades;

Grade 0 - No pain problem in the prior 6 months;

Grade I - Low pain intensity (intensity index <5/10) and low disability (<3 disability points);

Grade II - High pain intensity (intensity index ≥5/10) and low disability (<3 disability points);

Grade III - Moderate disability (3-4 disability points), regardless of pain intensity;

Grade IV: High disability (5-6 disability points), regardless of pain intensity.

Accordingly, the current operationalization is largely similar to the original GCPS of which the validity has been demonstrated among general non-clinical population and adult samples with chronic pain [14,21,30,62]. Further, preliminary findings of Huguet and Miró [27] and Wager et al. [64], although utilizing pain grading somewhat differently than originally proposed (i.e., covering the past 3 months instead of 6 months and including a more comprehensive assessment of disability), support the applicability and validity of the algorithm based upon Von Korff et al. [63] to grade pain severity among school children and clinical pediatric samples, respectively.

2.2.4 Child/adolescent school-related functioning

Several measures were used to assess school-related functioning including school attendance, academic performance, school-related pressure, school-related satisfaction and peer victimization (i.e., being bullied at school). The majority of these measures, except school attendance, were mandatory or optional questions in the cross-national 2009/2010 HBSC survey.

2.2.4.1 School attendance

Children and adolescents were requested to indicate the number of days they had been absent from school due to pain problems in the past 6 months. Expected number of school days was fairly consistent across the sample, given that all data were collected within a two month period in the spring. This item was added to the general cross-national HBSC 2009/2010 survey in the Flemish speaking region of Belgium only.

2.2.4.2 Academic performance

Children and adolescents provided subjective reports on how the teacher(s) evaluates their academic performance. This was elicited with the question 'In your opinion, what does your class teacher(s) think about your school performance compared to your classmates'. This item was rated on a 4-point scale with the endpoints 'below average' to 'very good'.

2.2.4.3 School-related pressure

Child/adolescent perceived school-related effort was measured by means of 4 items (e.g., 'I have too much school work', 'I have more school work than I can handle') rated on a 5-point scale with the endpoints 'almost never' to 'very often'. These items constitute a measure of perceived excessive school demands [55]. Cronbach's alpha in the current study was .83.

2.2.4.4 School-related satisfaction

School satisfaction was measured by means of 1 item. Specifically, children and adolescents were requested to indicate 'how they felt about school at present' using a 4- point

scale with the endpoints 'I don't like it at all' to 'I like it a lot'. This item is intended to measure the student's global feeling about school as a whole.

2.2.4.5 Being bullied at school

Children and adolescents were also requested to indicate how much they had been bullied at school during the past couple of months using a 5-point scale with the endpoints 'I have not been bullied at school in the past couple of weeks' to 'several times a week'. To ensure children/adolescents understand what is meant with being bullied, they are provided with a short description describing the key elements of being bullied, namely (1) involvement of physical or verbal aggression where the bully asserts power over the victim and (2) repetition over time (i.e., not a single incident). For a full description see Olweus [41].

2.2.5 Teacher support

Child/adolescent perceived teacher support was indexed by 8 items reflecting two different dimensions derived from self-determination theory [12,40,46], i.e., *competence* and *autonomy* support. Participants were requested to rate each item on a 5-point scale with the endpoints 'strongly disagree' to 'strongly agree' (e.g., *Autonomy* support: 'my teachers try to understand how I see things before suggesting a new way to do things; *Competence* support: 'My teachers encourage me when I do school work'). Items included in the current survey were piloted in Austria, Norway and Denmark in Spring 2009, using the SDT framework [12,40,46] to develop and refine survey items. Factor analysis indicated adequate factor structure and internal consistency for the dimensions of competence and autonomy [see 23]. Cronbach's alpha in the current study was .84 and .78, respectively.

2.5 Plan of statistical analyses

The data were analysed using SPSS (Version 20.0). Significance levels were set at $p < .05$. Comparisons between pain grade groups for socio-demographic categorical data (sex, age group, family situation, family affluence) were calculated using chi-square test. To examine

differences between pain grade groups with regard to (continuous) pain-related variables (pain intensity, frequency, health care utilization, pain interference, disability days) and school-related variables (days absent from school, academic performance, school-related pressure, school-related satisfaction, being bullied at school, teacher support), univariate analyses of variance (ANOVAs) were executed with a Bonferroni post hoc comparison. To ease interpretability of results, effect sizes for significant group comparisons are reported. For chi-square tests Cramer's V was used (>.1 = small; >.3 = medium; >.5 = large effect according to Cohen [5]). For ANOVA results, partial eta squared ($\square^2_p$) was used (>.01 = small; >.06 = medium; >.14 = large effect [see 7]).

To investigate the relationship between pain grade and school-related functioning and the moderating role of perceived teacher support of competence or autonomy, univariate ANOVAs were performed with pain grade as between subject factor and perceived teacher support of competence and autonomy entered as covariates and either days absent from school, academic performance, school-related pressure, school-related satisfaction or being bullied at school as dependent variable. Entering perceived teacher support of autonomy and competence simultaneously as separate covariates was based upon previous findings indicating that both support dimensions are related but distinct dimensions and hence, may differentially impact outcomes [see e.g., 52,57]. In case of significant interaction between pain grade and perceived teacher support of competence or autonomy upon school-related outcomes, separate moderation analyses were performed to interpret the interaction effect – i.e., whether the association between the predictor variable (pain grade) and outcome variable (school-related functioning; i.e., days absent from school, academic performance, school-related pressure, school-related satisfaction, being bullied at school) was significant at high or low (or both) levels of the moderator variable (perceived teacher support of competence or autonomy). Moderation analyses followed the procedure outlined by Holmbeck [26]. Using

this procedure, two new conditional continuous moderator variables were computed by (1) subtracting 1 *SD* from the centred moderator variable (to compute high levels of teacher competence or autonomy support) and (2) adding 1 *SD* to the centred moderator variable (to compute low levels of perceived teacher support of competence or autonomy). Next, two additional ANCOVAs were performed -- incorporating each of these new conditional continuous moderator variables -- to test the significance for high and low values of the conditional moderator variable.

3. RESULTS

3.1. Descriptive statistics

Mean scores, standard deviations and correlations between continuous measures are shown in Table 1. Pearson correlation analyses indicated that higher scores on all pain characteristics were associated with worse school-related functioning for all school outcomes, except academic performance which was negatively related to mean pain intensity and daily interference only. Of further interest, higher scores on perceived teacher support of competence or autonomy were associated with better school-related functioning for all school outcomes, except being bullied at school. Higher levels of perceived teacher support of competence or autonomy were also associated with better pain characteristics for all pain indices, except health care utilization which was negatively correlated with perceived teacher support of autonomy only. Of all pain locations, headache, abdominal pain, back pain and musculoskeletal pain were most frequently experienced. Specifically, 47.6% of the children and adolescents reported headaches, 47.5% abdominal pain, 38.6 % back pain and 38.6 % reported musculoskeletal pain at least about every month. Furthermore, these pain locations were also most likely to be identified as most troublesome pain location in the previous six months (headache; 24.1 %, abdominal pain; 21.5%,, back pain;12.1% and musculoskeletal

pain;11.4%). Further, examination of the frequency of abdominal pain in girls indicated that frequency of abdominal pain was significantly higher among girls who had begun to menstruate (M = 2.08) compared to those who had not (M = 1.84; t(5316) = 7.99, p □.0001).

Further, correlation analyses with the child/adolescent age indicated that higher child/adolescent age was associated with worse pain characteristics for all indices (all $r \geq .04$, $p > .0005$), with worse school-related functioning for all indices (all $r \geq |.14|$, $p > .0005$) except for being bullied (all r = -.17, $p > .0005$) and with lower levels of perceived teacher support of competence (r = -.24, $p > .0005$). Furthermore, girls reported -in comparison to boys- higher mean pain intensity, more days in pain, higher daily interference by pain, but better academic performance, more school-related satisfaction and being less bullied (all $t \geq 3.75$, $p < .0005$).

- INSERT TABLE 1 ABOUT HERE -

3.2 Severity of pain

Ninety-five percent of all children/adolescents (485 missing values) could be classified into one of the five grades of the GCPS: grade 0: pain free (N = 1848; 18.2%); grade I: low pain intensity-low disability (N = 4987; 49.1%); grade II: high pain intensity-low disability (N = 1941; 19.1%); grade III: moderate disability, regardless of pain intensity (N = 1095; 10.8%); grade IV: high disability-regardless of pain intensity (N = 294; 2.9%).

Examination of the relationship between pain grade and socio-demographic variables (see Table 2) suggests that boys were – compared to girls - more often classified in grade 0 (pain-free) and less likely to be classified in grade II. Further, children from the lower age groups (10-12y; 13-15y) were less often classified in grade IV (high disability) compared adolescents in older age groups (16+). Sex and age differences in the prevalence of pain problems resemble those reported in several other studies [27,43]. Further, also family situation and family affluence was associated with pain grade classification such that children

who grow up in a one-parent family/ parent and stepparent family and who reported lower family affluence appear more likely to be classified in higher pain grades.

Examination of the relationship between pain grade and pain characteristics indicated that, overall, scores on all pain indices (i.e., mean pain intensity, number of pain days, health care utilization, disability days and interference with daily activities) increased with increasing pain grades (all $F \geq 363.06$, $p < .0005$, $\square^2_p$ Range; .13-.75). As such, these findings attest to the utility and validity of the current pain grading operationalization to classify pain child/ adolescent problem severity.

- INSERT TABLE 2 ABOUT HERE -

3.3 Severity of pain in relationship to school-related functioning and teacher support

Higher pain grades were associated with poorer outcomes across all indices of school functioning (i.e., school absenteeism, school-related pressure and satisfaction and bullying experiences), with the exception of academic performance. Specifically, as shown in Table 3, findings indicated that higher pain grades were associated with an increasing number of days absent from school due to pain problems in the last 6 months. No clear pattern was observed for academic performance. In particular, children in grade 0 reported higher academic performance than children in grades II and III, yet children in grade 0 and I did not differ on perceived academic performance from children classified in grade IV. Interestingly, children/adolescents in the higher pain grades (grades II, III, IV) reported more school-related pressure, less satisfaction regarding school and more frequent instances of being bullied than pain-free children/adolescents (grade 0) or those reporting only low pain intensity and disability (grade I). Further, examination of the relationship between pain grade and perceived teacher support of competence or autonomy indicated that increasing pain grade was associated with lower rates of teacher support. Specifically, perceived level of teacher support of competence in pain grades II, III, IV was lower compared to pain-free children/adolescents

(grade 0) or those reporting only low pain intensity and disability (grade I). Perceived level of teacher support of autonomy was lower among children/adolescents in the highest pain grades (II, III, IV) compared to pain-free children/adolescents (grade 0).

- INSERT TABLE 3 ABOUT HERE -

3.4 Moderation of the relationship between pain severity and school-related functioning by perceived teacher support of competence and autonomy

Examination of *days absent from school* revealed pain grade significantly interacted with perceived teacher support of competence ($F(4,9941) = 18.48$, $p < .0005$) and autonomy ($F(4,9941) = 2.66$, $p < .05$) indicating that the association between pain grade and days absent from school varies with varying levels (i.e., low vs high) of teacher support of competence and autonomy.

To interpret the significant pain grade x competence support interaction separate ANOVAs were performed with low or high values of teacher support of competence. Results of these analyses are plotted in Figure 1 and suggest that high perceived teacher support of competence buffers against the harmful effects of severe pain upon school absenteeism. Indeed, contrast analyses indicated that school absenteeism significantly increased with increasing pain grade in case of low levels of perceived teacher support of competence, (see dotted lines Figure 1; $M_{\text{pain grade 0}} = 0.25 < M_{\text{pain grade 1}} = 1.84 < M_{\text{pain grade 2}} = 2.92 < M_{\text{pain grade 3}} = 5.65 < M_{\text{pain grade 4}} = 18.72$). However, in case of high perceived teacher support of competence, school absenteeism significantly increased from grade 0 to grade III, but remained stable in grade IV (see dotted lines Figure 1; $M_{\text{pain grade 0}} = 0.21 < M_{\text{pain grade 1}} = 1.92 < M_{\text{pain grade 2}} = 3.3 < M_{\text{pain grade 3}} = 6.56 = M_{\text{pain grade 4}} = 6.37$).

Comparable findings were observed for the pain grade x autonomy support interaction (see Figure 2). Specifically, contrast analyses indicated that school absenteeism significantly increased with increasing pain grade in case of low levels of perceived teacher support of

autonomy, (see dotted lines Figure 2; $M_{\text{pain grade 0}} = 0.24 < M_{\text{pain grade 1}} = 1.84 < M_{\text{pain grade 2}} = 3.15 < M_{\text{pain grade 3}} = 5.86 < M_{\text{pain grade 4}} = 18.37$). In case of high perceived teacher support of autonomy, school absenteeism significantly increased from grade 0 to grade III, yet, as with findings on perceived competence support, remained stable in grade IV (see dotted lines Figure 2; $M_{\text{pain grade 0}} = 0.22 < M_{\text{pain grade 1}} = 1.91 < M_{\text{pain grade 2}} = 3.01 < M_{\text{pain grade 3}} = 6.32 = M_{\text{pain grade 4}} = 6.55$).

- INSERT FIGURE 1 ABOUT HERE -

- INSERT FIGURE 2 ABOUT HERE -

The analyses with *academic performance, school-related pressure* and *school-related satisfaction,* respectively, revealed none of the pain grade x competence support and Pain Grade x autonomy support interactions were significant (all $F \leq 1.86$, ns). For all three analyses, only significant effects of pain grade (all $F \geq 18.16$, $p < .0001$, except academic performance; $F(4,9901) = 2.14$, $p = .07$), perceived teacher support of competence (all $F \geq 4.48$, $p < .05$) and autonomy (all $F \geq 60.86$, $p < .0005$) were observed indicating that higher levels of perceived teacher support of competence and autonomy are associated with higher perceived academic performance, lower perceived school-related pressure and higher school-related satisfaction. Effects of pain grade for academic performance, school-related pressure and school-related satisfaction are shown in Table 3.

The analyses with *being bullied at school* revealed pain grade significantly interacted with perceived teacher support of competence ($F(4,9804) = 3.31$, $p < .05$). No significant main or interaction effect was observed for perceived teacher support of autonomy (both $F \leq 1.29$, ns). Separate ANOVAs with low and high values of perceived teacher support of competence suggest that teacher support of competence protects against the harmful effects of severe pain upon being bullied (see Figure 3). Indeed, contrast analyses indicated that, in case of low perceived teacher competence support, children/adolescents in grade 4 reported

significantly more instance of being bullied compared to those in grade III and II, who in turn, reported higher levels of being bullied compared to children/adolescents in grade I and 0 (see dotted lines Figure 3; $M_{\text{pain grade 0}} = 1.36 = M_{\text{pain grade 1}} = 1.35 < M_{\text{pain grade 2}} = 1.64 = M_{\text{pain grade 3}} = 1.61 < M_{\text{pain grade 4}} = 1.83$). However, in case of high perceived teacher competence support, instances of being bullied significantly increased from grade 0 to grade II, but remained stable in grade III and IV (see dotted lines Figure 3; $M_{\text{pain grade 0}} = 1.27 < M_{\text{pain grade 1}} = 1.41 < M_{\text{pain grade 2}} = 1.58 = M_{\text{pain grade 3}} = 1.62 = M_{\text{pain grade 4}} = 1.59$).

- INSERT FIGURE 3 ABOUT HERE -

4. DISCUSSION (Word limit: 1500 / word count: 1496)

The current study examined whether child and adolescent pain severity relates to poorer school functioning and, in line with self-determination theory [12,40,44,46], the potentially protective role of perceived teacher support of child/adolescent autonomy and competence. Data for the present study were obtained from a large representative sample of Flemish speaking school children and adolescents whose pain severity was graded using a classification system for pediatric pain adapted from that of Von Korff et al. [63]. As such, the current study also provided insight into the prevalence of pain problems among Flemish speaking children/adolescents while taking into account the role of severity within the realm of school functioning [61].

The current study is among the first to apply Von Korff et al.'s [63] classification system for pain grading among the general pediatric population. Findings indicated that while the majority of children/adolescents were able to function well regardless of their pain intensity, a sizeable proportion of children reported moderate to severe pain problems (i.e., about 14 % of children and adolescents were classified in Grade III or IV). So far, only Huguet and Miro [27] applied pain grading to a sample of school children. Their results show

a smaller percentage of children with moderate to severe pain (i.e., about 5 % classified in Grade III or IV). Direct comparison between the studies is limited, however, because of differences in how the pain grading system was operationalized. Given our larger, more representative sample, our pain grading prevalence estimates are likely to be more reliable.

Of particular interest for the present study, the current findings corroborate the few pediatric pain studies indicating that pain is associated with hampered school functioning across a number of domains [e.g., 25,29,38]; however, they extend previous findings deriving from the application of pain grading to school children and adolescents [27] with chronic pain [64] that only included assessment of school absenteeism. The current findings indicate that greater pain severity was not only associated with school absenteeism but also with increased school-related pressure, decreased school-related satisfaction and increased bullying experiences. As such, these findings are among the first to indicate that greater pain severity, reflected by increased interference with daily functioning, translates to various domains of school-related functioning.

In other words, it is not only the presence versus absence of pain that affects school-related functioning. Rather, there appears to be a dose-response function, with increased pain severity associated with increased school impairment. Importantly, our findings also suggest that less severe pain problems should not be dismissed as irrelevant. Specifically, in comparison to pain-free children/adolescents (i.e., classified in Grade 0), children/adolescents with mild pain problems (i.e., classified in Grade II and thus characterized by low disability) already showed hampered school functioning for the majority of school indices.

Surprisingly, higher pain severity did not relate to lower academic performance. The assessment of academic competence in this study was based on a single adolescent-report item that may measure adolescents' own perceptions of their academic competence. Previous studies of school functioning in the context of chronic pain have also found that adolescents'

self-perceived academic competence was unrelated to pain severity [see e.g., 38]. Nevertheless, our findings underline that increasing pain severity may put children/adolescents at increased risk for hampered school-related functioning in other domains which, if not given appropriate attention, may facilitate a downward spiral of increasing severity, thus adversely impacting developmentally normative academic and psychosocial experiences central to healthy adjustment [12,15].

Although the cross-sectional nature of the current study and sole reliance on child/adolescent report warrants caution when drawing conclusions, our findings suggest that teacher support of student competence and autonomy may be an important, though previously unexplored, protective factor within a comprehensive model regarding the influences on school outcomes among children and adolescents with pain. Extending previous findings, our results suggest that teacher support of competence and autonomy may not only directly facilitate positive school-related outcomes [2,40,56,58] but may also protect highly vulnerable children - particularly those with most severe pain problems- from poorer school-related outcomes (i.e., increased absenteeism and bullying experiences). While further research is needed to examine mechanisms underlying the protective role of teacher competence and autonomy support, one plausible explanation is that environments characterized by high autonomy and competence support effectively enhance the children/adolescents' sense of *self-determination* [see e.g., 46,53,58].. According to Self Determination Theory, level of self-determination (comprising experience of choice, mastery and self-direction), is a key motivational resource for optimal functioning in diverse life-domains, including educational settings [12,40,46]. Alternatively, autonomy and competence support may also enhance child/adolescents' behavioural and emotional *engagement* in the school setting reflected by increased effort and interest, thereby promoting adaptive school functioning [see e.g.,

47,49,51,59]. Importantly, this possibility is not incompatible with the previously provided explanation.

Enhancing children's/adolescents' sense of self-determination and engagement with school may be particularly important in the context of pain. Specifically, previous studies have shown that pain is associated with lower perceived competence [6,65], hampered autonomous behaviour as reflected by lower perceived level of independence compared to peers [16,42], and increased social isolation [24,29,50]. However, how teachers' support of autonomy and competence exerts a protective influence deserves further study. The finding that teacher support exerted the most significant buffering effects for students with the most severely disabling pain is not surprising; given that these children overall had the most extensive school impairment, there was more potential for a positive impact from teacher support. Further research could clarify why this effect is not found at lower levels of disability. Likewise, further research is needed to examine why the protective effects of teacher support of students' competence (and to a lesser extent of autonomy) were found only for school absence and bullying experiences but not for other indices of school-related functioning. Arguably, absentee rates and reports of bullying may be the least subjective outcomes among those assessed in this study. Perhaps the protective effects of teacher support are most apparent in domains that are less dependent on self-perception. However, more empirical investigation is needed to go beyond speculation.

Although replication is needed, the present findings suggest that expanding teachers' existing motivational style to be more supportive of autonomy and competence might be an effective starting point for school-based interventions [see e.g., 45,46,47] and likely to be critical for children/adolescents with most severe pain problems who are particularly vulnerable for hampered school functioning. Accumulating evidence has shown that implementation of such interventions are relatively easy and effective [5,47,54]. Thus,

interventions aimed at improving school functioning in the context of pain should not only target children's internal processes and school-related behaviors but should likewise incorporate information and practice recommendations for classroom instructors, whose responses may critically influence the child's ultimate ability to function in school. Preliminary findings that teachers feel inadequately educated about how to work with students suffering from pain suggest that providing teachers tools to teach the child to effectively cope with pain is particularly needed [33,34,35]. However, it remains to be addressed whether targeted pain-related interventions aimed at improving school functioning become more effective if school personnel are actively involved in treatment [3].

A number of limitations deserve consideration. First, the study sample consisted of school children and adolescents who are currently *in* school. Findings may not generalize to clinical samples of children with chronic or recurrent pain and children with pain who drop out of school entirely or are home-schooled. Second, findings were based on cross-sectional and correlational data and, hence, do not indicate causal effects. It is plausible that hampered school-related functioning, such as being bullied or being highly stressed because of high school demands, makes one more vulnerable to severe pain experience [see e.g., 17,19]. Likewise, it is possible that child/adolescent school functioning and pain characteristics shape perceptions of teacher support rather than the inverse. Longitudinal studies are needed to follow trajectories of school functioning, teacher support, and pain over time. Third, observed differences in school-related outcomes as a function of pain grade were of small to medium effect sizes. Clinical significance of these differences remains to be addressed [1]. Related to this, the item assessing number of days absent from school due to pain partially overlaps with the GCPS item assessing number of days unable to carry out activities due to pain. It is possible that the pain-related item content inflated the effects of pain grade on school absenteeism. While the current investigation extended the examination of school impairment

beyond school absence, only child subjective self-reports were obtained. Additionally, the current study examined the buffering role of two specific teacher support dimensions. Future research may benefit from including multiple informants and more objective indicators (e.g., reports of child absence/academic performance obtained from the school/teacher/parent) as well as other types of support (e.g., pain-specific coping support [60] from various support providers including teachers, parents [37] and peers [29,50].

Despite limitations, the current study extends our understanding of the effects of pain severity on various dimensions of the child/adolescents school experience among a community sample of school-aged children and adolescents as well as the protective role of teacher support of child/adolescent competence and autonomy. Further research is needed to replicate and examine additional perspectives suggested by the current findings.

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FIGURE LEGENDS

Figure 1: Mean number of days absent from school during the past 6 months as a function of Pain Grade (0-IV) and low (-1SD below the mean) and high (+1SD above the mean) levels of perceived teacher competence support.

*** $p < .0005$

Figure 2: Mean number of days absent from school during the past 6 months as a function of Pain Grade (0-IV) and low (-1SD below the mean) and high (+1SD above the mean) levels of perceived teacher autonomy support.

*** $p < .0005$

Figure 3: Mean of being bullied during the past 6 months as a function of Pain Grade (0-IV) and low (-1SD below the mean) and high (+1SD above the mean) levels of perceived teacher competence support.

*** $p < .0005$

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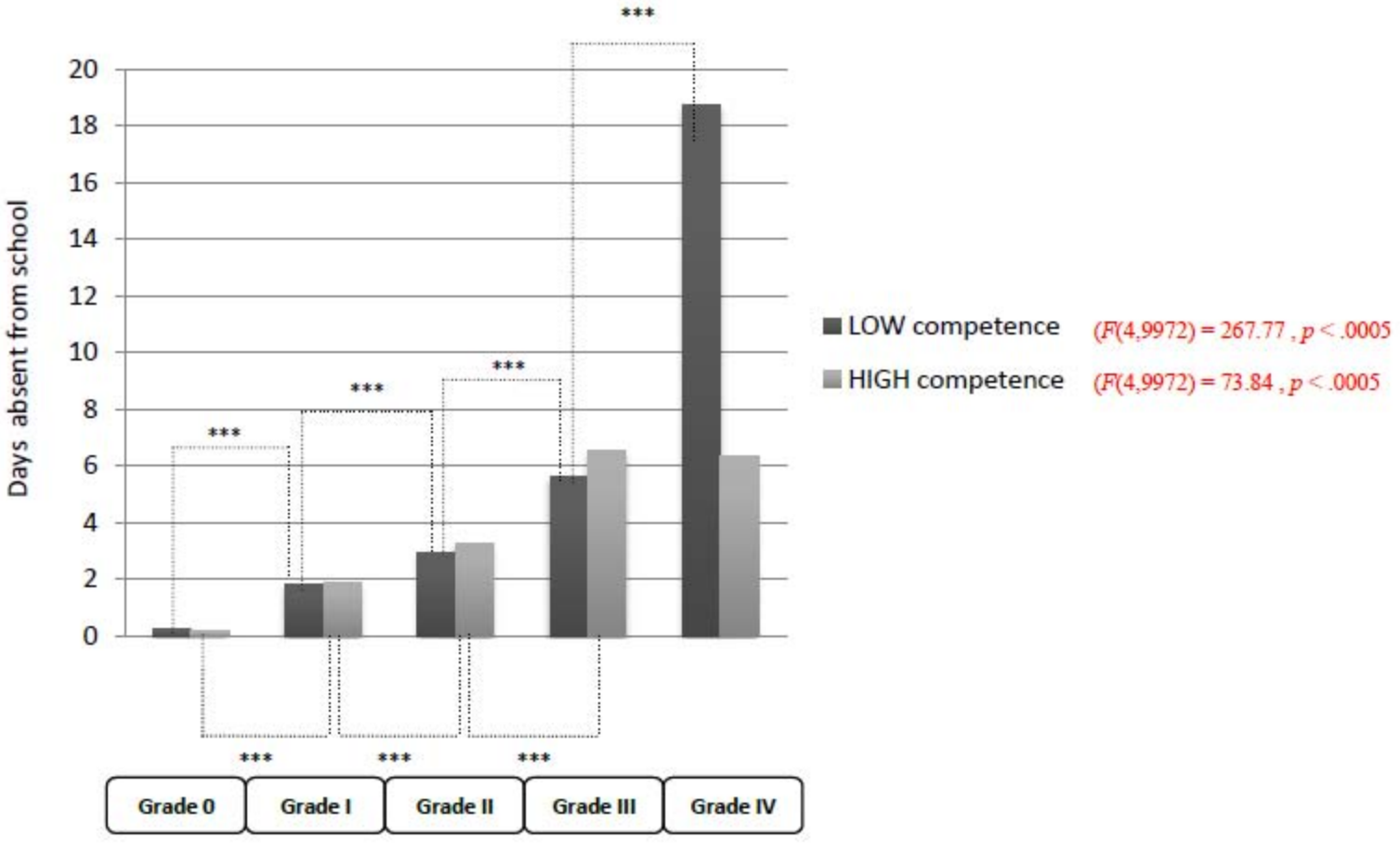
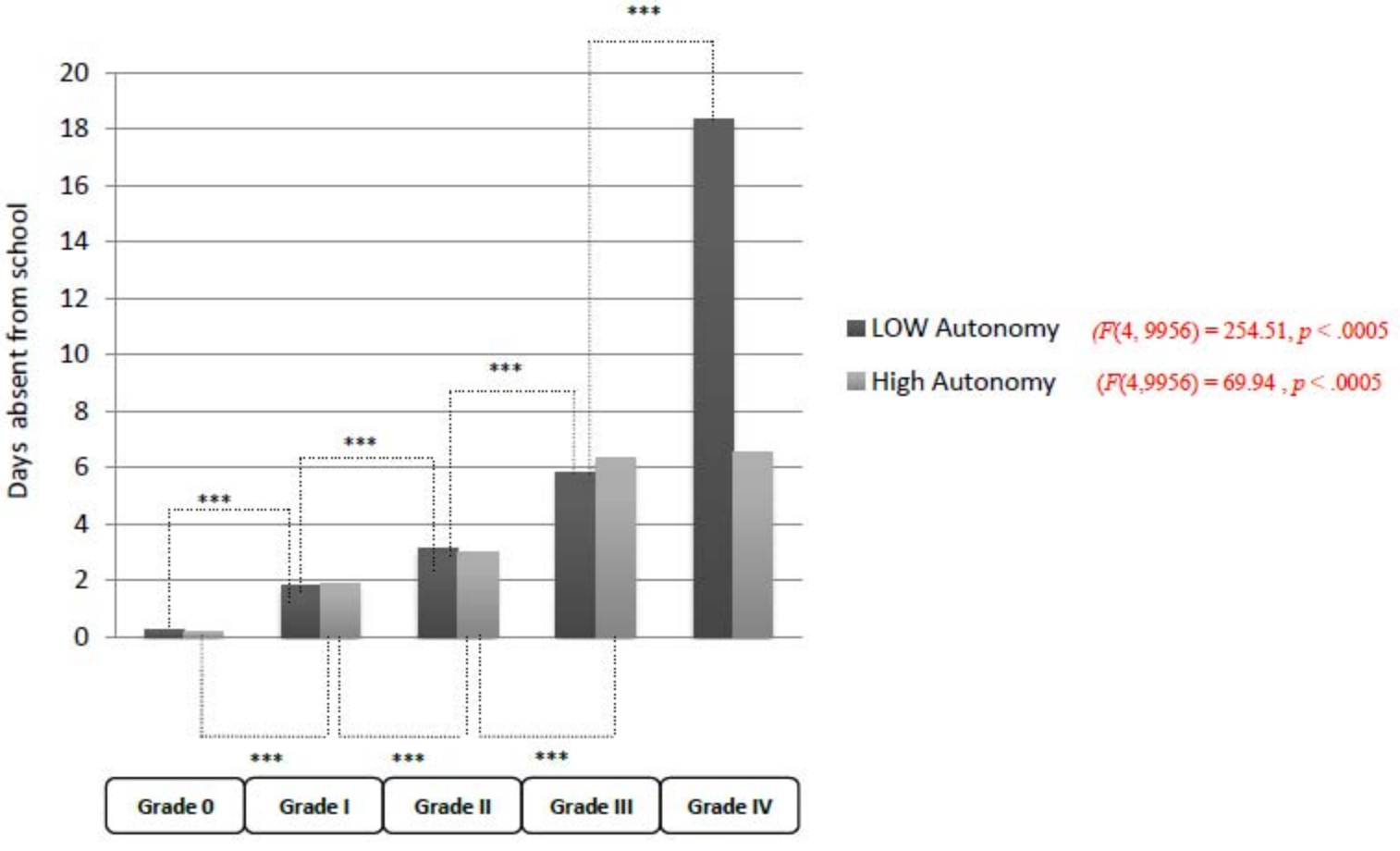

Days absent from school
20
18
16
14
12
10
8
6
4
2
0
***
***
***
***
***
***
Grade 0
Grade I
Grade II
Grade III
Grade IV
LOW competence
HIGH competence
(F(4,9972) = 267.77 , p < .0005
(F(4,9972) = 73.84 , p < .0005


Days absent from school
20
18
16
14
12
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6
4
2
0
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***
Grade 0
Grade I
Grade II
Grade III
Grade IV
LOW Autonomy
High Autonomy
(F(4, 9956) = 254.51, p < .0005
(F(4,9956) = 69.94 , p < .0005

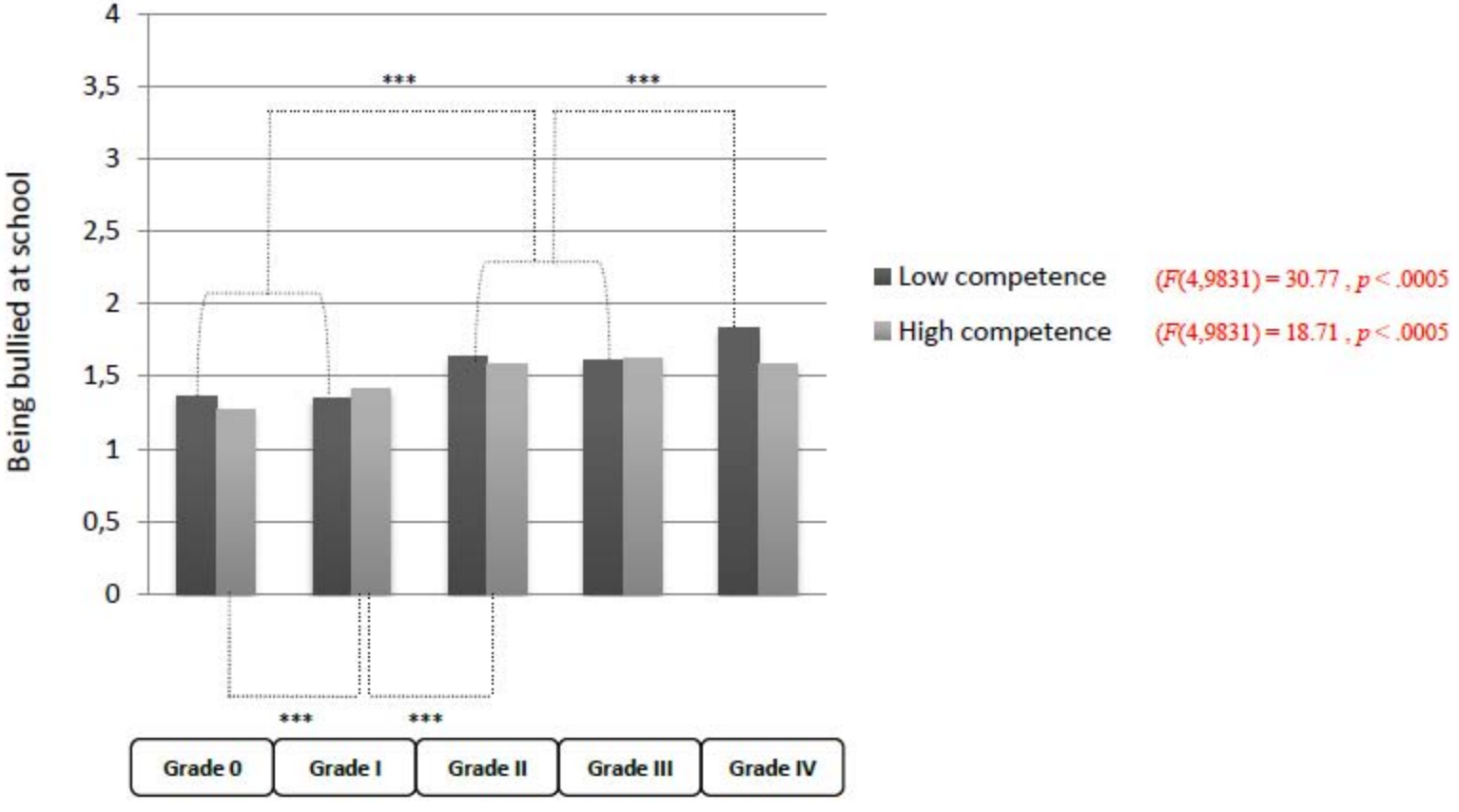
Being bullied at school
4
3,5
3
2,5
2
1,5
1
0,5
0
***
***
***
***
Grade 0
Grade I
Grade II
Grade III
Grade IV
Low competence
High competence
(F(4,9831) = 30.77 , p < .0005
(F(4,9831) = 18.71 , p < .0005

Table 1. Means (M), Standard Deviations (SD), and Pearson Intercorrelations of the continuous measures.

	M (SD)	*N*	2	3	4	5	6	7	8	9	10	11	12
1. Mean pain intensity	3.30 (2.47)	10438	.52***	.25***	.29***	.64***	.22***	-.04***	.11***	-.10***	.14***	-.06***	-.07***
2. Number of pain days	15.90 (22.67)	10145	---	.27***	.32***	.38***	.23***	-.01	.09***	-.11***	.09***	-.09***	-.10***
3. Health care consultation	1.95 (6.31)	10428		---	.41***	.28***	.46***	.00	.06***	-.04***	.08***	-.01	-.03**
4. Disability days	3.61 (11.36)	10374			---	.36***	.37***	.01	.04***	-.06***	.06***	-.05***	-.05***
5. Interference with daily activities	2.40 (2.58)	10475				---	.26***	-.03**	.10***	-.10***	.12***	-.05***	-.05***
6. Days absent from school	2.67 (8.23)	10448					---	-.02	.03**	-.05***	.07***	-.03**	-.04***
7. Academic performance	2.68 (.83)	10476						---	-.33***	.24***	.01	.17***	.17***
8. School-related pressure	10.86 (3.63)	10517							---	-.33***	.03**	-.33***	-.33***
9. School-related satisfaction	2.86 (.89)	10532								---	-.10***	.33***	.33***
10. Being bullied at school	1.45 (.95)	10340									---	-.02	-.02
11. Teacher competence support	14.07 (3.11)	10511										---	.73***
12.Teacher autonomy support	13.35 (3.31)	10489											---

Note. Mean pain intensity is the mean of average pain in the past six months, worst pain intensity in past six months and pain at the moment of testing

*** p < .0005; ** p<.005; * p<.01; # p<.05

Table 2
Sociodemographic variables in relation to Pain Grade

	Grade 0 *N* (%)	Grade I *N* (%)	Grade II *N* (%)	Grade III *N* (%)	Grade IV *N* (%)	Chi Square (df)	Effect size (Cramer's V)
Sex						179.26*** (4)	.13
Boys	1131 (21.8%)	2587 (49.8%)	774 (14.9%)	522 (10.1%)	150 (3.3%)		
Girls	717 (14.3%)	2400 (48.0%)	1167 (23.2%)	573 (11.5%)	144 (2.9%)		
Age group[a]						67.73*** (12)	.05
10-12 y	699 (20.2%)	1639 (47.4%)	663 (19.16%)	384 (11.1%)	75 (2.2%)		
13-15 y	651 (18.20%)	1762 (49.4%)	714 (20.0%)	358 (10.0%)	84 (2.4%)		
16-18 y	467 (15.7%)	1512 (50.94%)	536 (18.1%)	330 (11.1%)	123 (4.1%)		
19-21 y	29 (18.4%)	70 (44.3%)	26 (16.5%)	21 (13.3%)	12 (7.6%)		
Family situation						290.25*** (12)	.10
Classic family	1175 (17.4%)	3516 (52.1%)	1211 (17.9%)	664 (9.8%)	183 (2.7%)		
One-parent family	207 (15.2%)	615 (45.3%)	303 (22.3%)	189 (13.9%)	45 (3.3%)		
Parent and stepparent	191 (14.4%)	606 (45.7%)	320 (24.1%)	172 (13.0%)	37 (2.8%)		
Other	275 (37.6%)	250 (34.2%)	107 (14.6%)	70 (9.6%)	29 (3.9%)		
Family affluence[b]						22.51** (8)	.04
Low	307 (16.3%)	890 (47.3%)	400 (21.3%)	224 (12.0%)	60 (3.2%)		
Medium	784 (16.3%)	2414 (50.2%)	968 (20.1%)	504 (10.5%)	142 (3.0%)		
High	443 (17.5%)	1310 (51.8%)	424 (16.7%)	276 (10.9%)	75 (3.0%)		

Note. [a]For *N*=12 missing information; [b]For *N*=1030 missing information; *** p < .0005; ** p<.005

Table 3
School functioning and teacher support in relationship to Pain Grade

	Grade 0 *M (SD)*	Grade I *M (SD)*	Grade II *M (SD)*	Grade III *M (SD)*	Grade IV *M (SD)*	*F*-test	Effect size (Partial eta squared)
Days absent from school	.21 (2.30)[a]	1.88 (5.20)[b]	3.10 (7.72)[c]	6.06 (12.91)[d]	14.11 (23.38)[e]	275.65***	.10
Academic performance	2.74 (.84)[a]	2.69 (.82)[a.b]	2.64 (.82)[b]	2.65 (.86)[b]	2.69 (.93)[a.b]	3.69*	.001
School-related pressure	10.46 (3.77)[a]	10.66 (3.42)[a]	11.33 (3.68)[b]	11.39 (3.79)[b]	11.60 (4.07)[b]	26.42***	.01
School-related satisfaction	2.97 (.90)[a]	2.91 (.84)[a]	2.78 (.91)[b]	2.70 (.94)[b]	2.64 (.96)[b]	27.19***	.01
Being bullied at school	1.31 (.82)[a]	1.38 (.84)[a]	1.61 (1.12)[b]	1.61 (1.10)[b]	1.74 (1.21)[b]	44.21***	.02
Teacher competence support	14.27 (3.30)[a]	14.16 (2.92)[a,b]	13.90 (3.18)[c]	13.89 (3.26)[b,c,d]	13.33 (3.54)[d]	9.21***	.004
Teacher autonomy support	13.75 (3.46)[f]	13.37 (3.15)[a,b]	13.26 (3.34)[a,c,d]	13.13 (3.54)[b,c,e]	12.67 (3.66)[d,e]	10.82***	.004

Note. *** p < .0005; ** p<.005; * p<.01
Different indices indicate significant differences between groups.